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(54) Name of the invention: Substrate Plate Used in Plasma Display Devices and Its Manufacturing Method

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(54) [Name of the invention]

Substrate Plate Used in Plasma Display Devices and Its Manufacturing Method

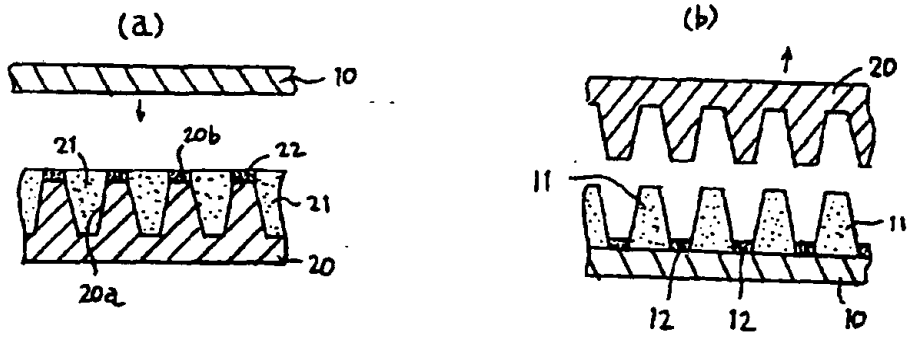
(57) [Summary]

[Topic]

The topic of the present invention is the a substrate plate that is used in plasma display devices and the easy formation of the microscopic shape of the barrier 11, at a high precision.

[Solution measures]

A substrate plate used in plasma display equipment is manufactured by a technological process where a mixed material 21, formed from ceramics or glass powder material a solvent media and organic additive materials, is filled inside the indented part 20 a of the molding die 20, and together with that on the protruded parts 20 b of the above described molding die, the electrode material 22 is coated, and these mixed material 21 and electrode material 22 are bonded to the back surface plate 10, that is formed from ceramics or glass.



[Range of the claims of the invention]

[Claim 1]

A substrate plate used in plasma display devices, characterized by the fact on a back surface plate, that is formed from ceramics or glass, numerous barrier, that are formed from ceramics or glass, are provided, and at the whole surface of the bottom surface of the cells that are formed in each space between these barriers, electrodes are provided.

[Claim 2]

Manufacturing method for the preparation of a substrate plate used in plasma display equipment, that consist of a technological process where a mixed material, formed from ceramics or glass powder material a solvent media and organic additive materials, is filled inside the indented part of the molding die, and together with that on the protruded parts of the above described molding die, the electrode material is coated, and these mixed material and electrode material are bonded to the back surface plate, that is formed from ceramics or glass.

[Detailed explanation of the invention]

[0001]

[Technological sphere pertinent to the present invention]

The present invention is an invention about a substrate plate that is used in plasma display devices, that in turn are used in high precision and also inexpensive thin shape large image surface using color display devices, etc., and its manufacturing method.

[0002]

[Previous technology]

In the case of the plasma display devices, that can be used in thin shape large image surface using color display devices, etc., they have a structure that is formed as n the spaces that are surrounded by barriers that are called fine display cells, opposing electrodes are provided, and in the above described spaces a rare gas, etc., discharge capable gas is introduced and sealed, and by the electrical discharge in the space between the opposing electrodes, plasma is generated, and by the above described plasma, a fluorescent light material is generated, and this is an item that is used as the light generating element of the image surface.

[0003]

A detailed structure is shown according to the presented in Figure 3, and according to that, on one surface of the back surface plate 10, a large number of barriers 11, are formed, and each space between the barriers 11, is used as the cells 13, and on the bottom surface of these cells 13, the electrodes 12, are provided, and this is used as the substrate plate 1. Relative to this substrate plate 1, on the inner wall surface 13 a of the cells 13, a fluorescent light material is coated, and on the other hand, the equipped with the electrodes 15 front plate 14, is bonded on the top of the barrier 11 of the substrate plate 1, and in the cells 13, gas is introduced and sealed and by that it is possible to form the structure of the plasma display device.

[0004]

However, at the time of the manufacturing of the substrate plate 1, that is used in the above described plasma display devices, in advance on the back surface plate 10, a large number of electrodes 12, is formed, and after that, in the space between each of the electrodes 12, the barriers 11, are formed. However, as the manufacturing method for the formation of these barriers 11, the printing laminated layer method and the green sheet multilayer methods, etc., have been known.

[0005]

Regarding the printing laminated layer method, by using a paste of the material that is forming the barriers 11, and by employing the thick layer printing method, on the top o the back surface plate 10, the predetermined pattern barriers 11, are printed and formed, and by that, the thickness that can be formed by a one time printing is in the

range of approximately 10 ~ 15 microns, and because of that, it is a case where the formation of the barriers 11 is conducted as the printing and the drying are repeated, so that the necessary height, that is in the range of approximately 100 ~ 200 microns, is obtained (as illustrated according to the reported in the Japanese Patent Application Laid Open Number Hei-Sei 2-213020).

[0006]

Also, regarding the blasting method, it is a method where over the whole surface of the back surface plate 10, a glass layer with the desired thickness, is formed, and on the front surface of that, a resistor mask with the shape of the barriers 11, is formed, and by using sand blasting, the glass layer of the parts outside the barriers 11, is removed (as illustrated according to the reported in the Japanese Patent Application Laid Open Number Hei-Sei 4-259728).

[0007]

[Problems solved by the present invention]

However, in the case of the substrate plate 1, used in plasma display devices, that has been manufactured according to the above described manufacturing method, the technological processes for the formation of the barriers 11 and the electrodes 12, are separate and because of that, it is easy to generate a deviation in the position of the barriers 11 and the electrodes 12, and there has been the problem that it is said to be difficult to obtain a high precision substrate plate 1. And not only that, but also, as it is shown according to the presented in Figure 3, it is not possible to avoid the presence of a gap between the electrodes 12 and the barriers 11, and the electrodes 12 are provided on only on one part of the bottom surface of the cells 13, and because of that, there has been the problem that it is said that the electrical discharge region is narrow and the light generation efficiency is low.

[0008]

Also, at the time of the manufacturing of the barriers 11, in the case of the above described printing laminated layer method, in order to form the barriers 11 with the predetermined height, it is necessary that several printing - drying technological processes are repeated, and the number of the technological processes becomes extremely large, and moreover, for each of the laminated layers it is necessary to have a printing with good precision, and because of that, the yield rate becomes extremely poor. Then, especially, because of the position deviation at the time of the printing, it is easy to change the shape of the barrier 11, and also, because of the elongation of the printing plate etc., as the precision of the dimensions of the display cells that are formed by the barriers 11, the largest difference of the measurement values at the time when the dimension of the 1000 cell part, was measured in 45 columns, was 0.35 mm, and it was a method that did not satisfy the requirements for

a high precision.

[0009]

On the other hand, in the case of the above described green sheet multilayer laminated layer method, it is a method where it is possible that a large number of punched green sheets is combined together and the layers are laminated and these are adhered, and the barriers 11, are formed, and the the pitch of the cells 30 is made to be extremely fine. And if, in order to have a high precision in the image surface, the barrier 11 part that is facing the opening part of the cells 13, is made to be narrow, the surface area of the open pores is made to be large, and by that the strength of the green sheet is decreased. And because of that, there has been the problem that it is said that it is difficult to obtain a high precision position determination at the time of the layer lamination.

[0010]

Also, besides that, in the case of the manufacturing by using a sand blasting method, the formation of the barriers 11 with a high precision, is difficult.

[0011]

Consequently, according to any of the above described manufacturing methods, the inexpensive and precision manufacturing of the substrate plate 1, that is used in a large form factor display devices, and that has a fine pitch, by a simple technological process, was difficult.

[0012]

[Goal of the present invention]

The present invention has taken into consideration the above described problem points, and its goal is to suggest a substrate plate, that is used in plasma display devices, and its manufacturing method, where the substrate plate that is used in the plasma display devices is manufactured by a one time simple molding technological process, and it is manufactured at a good yield rate, and together with that, high precision barriers that do not have a change in shape and that have a smooth front surface, are obtained at the predetermined height, and a large image surface of at least 40 inches or higher, can be easily obtained in practice.

[0013]

[Measures in order to solve the problem]

The substrate plate used in plasma display devices according to the present invention is a substrate plate used in plasma display devices, characterized by the fact on a back surface plate, that is formed from ceramics or glass, numerous barrier, that are formed from ceramics or glass, are provided, and at the whole surface of the bottom surface of the cells that are formed in each space between these barriers, electrodes are provided.

[0014]

Also, the manufacturing method for the preparation of a substrate plate used in plasma display equipment, according to the present invention, is characterized by the fact that consist of a technological process where a mixed material, formed from ceramics or glass powder material a solvent media and organic additive materials, is filled inside the indented part of the molding die, and together with that on the protruded parts of the above described molding die, the electrode material is coated, and these mixed material and electrode material are bonded to the back surface plate, that is formed from ceramics or glass.

[0015]

[Effect]

According to the substrate plate used in plasma display plates according to the present invention, over the whole bottom surface of the cells, electrodes are formed, and because of that, there is no difference between the positions of the electrodes and the barriers, and together with that the electrical discharge region, is expanded, and it is possible to increase the light generation efficiency.

[0016]

Also, according to the manufacturing method for the preparation of a substrate plate used in plasma display plates according to the present invention, a mixed material consisting of ceramics or glass powder material,and a binder, is filled in the molding die, and the barrier molded material, is obtained, and because of that, due to the fact that the state of the front surface of the barriers is good, and also, because the dimensional precision of the molding die is reflected in the molded material as it is, because of all of these, it is possible to easily manufacture a large scale substrate plate by a one time molding technological process.

[0017]

Also, because the barriers and the electrodes are formed as one body, it is possible to simplify the technological process, and together with that, it is possible to easily manufacture a substrate plate that has electrodes over the whole surface of the

bottom surface of the cells, and it is possible to eliminate the difference between the positions of the barriers and the electrodes.

[0018]

[Conditions of the practical implementation of the present invention]

In the description here below, the practical implementation of the present invention is explained.

[0019]

As it is shown according to Figure 1, the substrate plate 1, that is used in plasma display devices, is provided with the complex number of barriers 11, that are formed from ceramics or glass, on one surface of the back surface plate 11, that is formed from ceramics or glass, and in the space between each barrier 11, the cells 13 are formed.
Then, over the whole bottom surface of these cells 13, the electrodes 12, are provided,
and it becomes a tightly adhered state where there are no gaps between these electrodes 12 and the barriers 11.

[0020]

As this substrate plate 1, on the inner wall surface 13 a of the cells 13, a fluorescent light material is coated, and after that, as it is shown according to Figure 3, by using the front surface plate 14, that is provided with the electrodes 15, the upper edges of the barriers 11, are covered, and in the cells 13, gas is introduced and sealed off, and by that it is possible to form the structure of the plasma display device. Then, by the conducting of an electrical discharge in the space between the electrodes 12 and 15, it is possible to generate light in the fluorescent light material, that has been coated on the inner wall surface 13 a of the cells 13.

[0021]

At this time, because the above described electrodes 12 are provided over the whole surface of the bottom surface of the cells 13, the electrical discharge region is expanded, and the light generation efficiency is increased. Also, it is possible to not have a difference in the positions of the barriers 11 and the electrodes 12, and it is possible to obtain a high precision substrate plate 1.

[0022]

After that, the manufacturing method for the preparation of the above described substrate plate 1, is explained.

[0023]

First, as it is shown in Figure 2 (a), the molding die 20, that has the indented part 20 a, that coincides with the shape of the barriers 11, is prepared. And on the protruded parts 20 b, that are in between the indented parts 20 a of this molding die 20, the electrode material 22 that forms the electrodes 12, is coated. In more details, a mixed material is coated, that is formed from metal paste or metal powder, that form the electrodes 22, a binder material that comprises a solvent and organic additive. As the coating method, there is the method where on another flat plate etc., the electrode material 22 , is coated, and to that the protruded parts 20 b of the molding die 20, are copied, or it is a good option if onto the protruded parts 20 b of the molding die 20, the electrode material 22 is coated by using the screen printing method or the roller coating method, etc.

[0024]

After that, on the indented part 20 a of the molding die 20, as the material forming the barriers 11, a mixed material 21, that is formed from a ceramics or glass powder material, and a binder obtained from a solvent media and an organic additive materials, is filled. At this time, according to Figure 2 (a), the front surface of the electrode material 22 and the front surface of the mixed material 21, are the same surface, however, it is also a good option if the mixed material 21 covers the electrode material 22, and in either case, a state is obtained where there is no gap between mixed material 21 and the electrode material 22.

[0025]

On the other hand, the shown according to Figure 1 substrate plate 1, that is used in plasma display devices, can be manufactured by the method where the back surface plate 10, that is formed from ceramics or glass, is separately prepared, and then it is pressed relative to the upper surface of the mixed material 21, that is filled into the above described molding die 20 molded material from the above described mixed material 21, and the electrode material 22, and it is dried, and by that the mixed material 21 and the electrode material 22 are solidified (fixed). After that, as it is shown according to Figure 2, that shows the opposing top and bottom parts, the molding die 20 is die released and by that the barriers 11 and the electrodes 12 are copied (transferred) onto the surface of the back surface plate 10. And finally, the whole body is sintered at the same time, and by that the shown according to Figure 1 substrate plate 1, that is used in plasma display devices, can be manufactured.

[0026]

Moreover, according to the above described example, the barriers 11 and the electrodes 12 are bonded to the back surface plate 10, in a unsintered state, and

finally, these are sintered at the same time, however, it is also possible that in advance the barriers 11 and the electrodes 12 are solidified and separately sintered and after that they are adhered under heat and pressure or adhered onto the back surface plate 10, and by that they are bonded. namely, regarding the bonding of the barriers 11 and the electrodes 12, to the back surface plate 10, it is a good option if it is performed at any of the stages - the step where the parts are mutually non annealed molded materials, the step where they are in the state where the binder material has been removed, the step where it is an annealed bonded body.

[0027]

According to such manufacturing method of the present invention, the barrier 11 and the electrodes 12 can be formed by one step, and because of that, the manufacturing technological process can be extremely simplified. And not only that, but also, in the case of the barriers 11, the shape of the indented part 20 a of the molding die 20, is copied, and because of that it is possible to form a fine shape with a high precision. And as a result from that, according to the manufacturing method of the present invention, at the time when the dimension of the cell part of the display cell 1000, is measured in 45 columns, the largest difference in the measured values, is 0.05 mm or less, and it is possible to obtain a high precision.

[0028]

Here, as the ceramics powder material, that is used in order to form the barriers 11, it is possible to use any of the following materials: alumina (Al2O3), zirconia (ZrO2), etc., oxide type ceramics, or silicon nitride (Si3N4), aluminium nitride (AlN), silicon carbide (SiC) etc., non-oxide type ceramic materials. And in these ceramics powder materials, it is also possible to add predetermined amounts of different types of sintering promoting agents.

[0029]

As the above described sintering promoting agents, in the alumna powder material, it is possible to add predetermined amounts of silica (SiO2), calcia (CaO), yttria (YeO3) and magnesia (MgO), etc., and into the zirconia powder material, it is possible to add the predetermined amounts of yttria (Y2O3), or cerium (Ce), dysprosium (Dy), ytterbium (Yb), etc., oxide of rare elements, and also, in the silicon nitride powder material, it is possible to add predetermined amounts of yttria (Y2O3) and alumina (Al2O3), etc., and in the aluminium nitride powder material, it is possible to add predetermined amounts of oxides of elements from the Group 3 a of the periodic table of Chemical Elements (Re2O3), etc., and in the silicon carbide powder material, it is possible to add the predetermined amounts of boron (B) and carbon (C), etc.

[0030]

Also, as the glass powder material, that forms the barriers 11, it is possible to use different types of glass materials, containing as their main component silicate salts, and also containing one or more types of lead (Pb), sulfur (S0, selenium (Se), alum etc.

[0031]

Furthermore, regarding the grain size of these ceramics or glass powder materials, it is possible to appropriately use materials with a grain size from several tens of microns to submicrons, and in more details, it is a good option to use materials with a grain size that is in the range of 0.2 ~ 10 microns, and preferably, in the range of 0.2 ~ 5 microns.

[0032]

Then, as the organic additive materials, that are added to these ceramics or glass powder materials, urea resins, melamine resins, phenol resins, epoxy resins, unsaturated polyester resins, alkyd resins, urethane resins, ebonite, polysiloxy silicates, etc., can be used. Then, these organic additive materials, are cured by thermal curing, ultraviolet light radiation curing, X ray radiation curing, etc., and by that the barrier material 21 can be solidified. Moreover, from an operational point of view and equipment point of view, the thermal curing is the most preferred method. And especially, from the point of view of the "pot life", the unsaturated polyester resins are preferred.

[0033]

Regarding the contained amount of the above described organic additive materials, in order to maintain the flowability properties and the molding properties of the mixed material obtained from the ceramics or glass powder material and the sintering promoting agent, it is necessary that the viscosity is not increased, and on the other hand, it is desirable that at the time of the curing the mixed material has sufficient shape retention properties. And from these points of view, the contained amount of the organic additive materials, relative to 100 weight parts of the ceramics and glass powder material, is 0.5 weight parts or more, and also, from the point of view that it is said that there is shrinkage of the molded material upon curing, it is preferred that it is no more than 35 weight parts, or less, and among these amounts, if the shrinkage at the time of the sintering is considered, the amounts in the range of 1 ~ 15 weight parts, are most appropriate.

[0034]

Also, as the solvent media, that is added inside the mixed material 21, as long as it is a solvent agent that can dissolve the above described organic additive material,

there are no specific limitations, and for example, it is possible to use toluene, xylene, benzene, phthalic acid ester, etc., aromatic solvent agents, hexanol, octanol, decanol, oxyalcohol, etc., high homologous order alcohol type organic solvents, or acetic acid esters, glycerides, etc.

[0035]

Especially, the above described phthalic acid esters, oxy alcohols, etc., can be appropriately used, and especially, in order that the solvent media is volatilized gradually, it is also possible that 2 types or more of the above described solvent agents are used together. And also, regarding the contained amount of the above described solvent media, from the point of view of the molding properties, in order to maintain the shape retention properties of the molded material, it is necessary that it is contained in an amount of at least 0.1 weight parts or more, relative to 100 weight parts of the ceramics and glass powder material. And on the other hand, it is desirable that the viscosity properties of the mixed material obtained from the ceramics and glass powder material and the organic additive material, are made to be low, and because of that, it is desirable that the contained amount is no more than 35 weight parts, or less, and when he shrinkage at the time of the drying and at the time of the sintering is considered, it is most preferable that, the amount contained is in the range of 1 ~ 15 weight parts.

[0036]

Then, regarding the electrode material 22, that is used according to the present invention, it is possible to use a paste that is formed from Ag, Pd, Pt, Au, W etc., used individually, or in a combination, or a mixed material that is obtained from these metal powders and a binder that is formed from a solvent medium and an organic additive material.

[0037]

Moreover, regarding the molding die 20, according to the present invention, it is a good option if at the time when the organic additive materials are curing, there are other materials that are not harmful. And there are no specific limitations regarding these materials, and for example, it is possible to use metals and resins, or rubber etc., and if necessary, it is also a good option if, in order to increase the die release properties and to eliminate the wear, a surface treatment is conducted on the surface coating etc.

[0038]

Also, regarding the above described back surface plate 10, it can be a non-sintered green sheet or a sintered material, and there are no particular limitations regarding the material, and for example, different types of ceramic green sheets or different

types of glass substrate plates, porcelain substrate plates, etc., are preferred, because they have a thermal expansion coefficient that is close to that of the material used in the barriers 11.

[0039]

Moreover in the case of the bonding of the above described mixed material 21 or the electrode material 22 to the back surface plate 10, it is also a good option if these are bonded by using pressure adhesion without the presence of anything in between them, or is also possible that this is done by using an inorganic or organic type adhesive agent.

[0040]

Also, in order to increase the adhesive properties at the time of the pressure adhesion of the above described mixed material 21 or the electrode material 22 are adhered onto the back surface plate 10, it is possible to use silane coupling agents, or titanate coupling agents, aluminate coupling agents, etc., different types of coupling agents, and among those, the silane coupling agents are preferred because of the fact that they increase the reactivity properties.

[0041]

Then, regarding the pressure adhesion of the mixed material 21 or the electrode material 22, and the back surface plate 10, from the point of view that the pressure force is applied uniformly, it is desirable to use a hydrostatic pressure equipment, and as far as the elevated pressure conditions, they are within the range where there is no change of the shape of the molding die 20. And the above described pressure range varies depending on the strength of the molding die 20, however, for example, in the case when a molding die 20 manufactured from silicone rubber material, was used, it is preferred that the pressure adhesion is conducted under elevated pressure conditions of approximately 100 g/cm2.

[0042]

Also, in the mixed material 21, in order to increase the dispersibility properties of the ceramics or glass powder material, it is also a good option if a surface active agent is added, like polyethylene glycol ether, alkyl sulfonic acid salts, salts of polycarboxylic acids, alkyl ammonium salts, etc. And as far as the contained amount of these, from the point of view of increasing the dispersibility properties and the thermal degradation properties, it is preferred that the content is in the range of 0.05 ~ 5 weight parts, relative to 100 weight parts of the ceramics or the glass powder material.

[0043]

Then, in the binder of the mixed material 21, it is possible to add a cure catalyst, that can be a cure reaction promoting agent or a polymerization initiation agent etc. And as the above described cure catalyst agent, it is possible to use organic peroxide compounds or azo compounds. For example, it is possible to use ketone peroxide, diazyl peroxide, peroxy ketal, peroxy ester, hydroperoxide, peroxy carbonate, t-butyl peroxy - 2- ethyl hexanoate, bis (4-t- butyl cyclohexyl) peroxy dicarbonate, dicumyl peroxide, etc., azo compounds.

[0044]

And moreover, in Figures 1 and 2, the trapezoid shape of the barriers 11 is shown, however the present invention is not limited to this example.

[0045]

[Practical Examples]

Practical Example 1

First on a flat plate, as the electrode material 22, an Ag paste is coated, and the protruded parts 20 b of the molding die 20, are pushed against the above described flat plate, and by that the electrode material 22 is coated, and then it was dried. On the other hand, as the mixed material 21, that is used to form the barriers 11, as it is shown according to Table 1, glass powder material with an average particle diameter of 0.2 ~ 10 microns, (and preferably in the range of 0.2 ~ 5 microns) and different types of solvent media, organic additive materials and some dispersing agents, were added, and by that slurries were prepared. And these mixed materials 21, were then filled into the indented part 20 a of the molding die 20, and they were defoamed.

[0046]

On the surface of this, the manufactured from glass back surface plate 10, was placed, and pressure was applied, and it was dried, and after that the mixed material 21 and the electrode material 22 were solidified, and it was verified that they were bonded onto the back surface plate 10, and then the molding die 20 was released. After that, the whole body was sintered at a temperature in the range of 500 ~ 700oC, and by that the
substrate plate 1, that is used in plasma display devices, was obtained.

[0047]

[Table 1]

No	主成分	バインダー組成（重量部）					
		溶媒		有機性添加物		他の添加物	
1	ガラス	フタル酸ジエチル	10	不飽和ポリエステル	15	分散剤	2
2	〃	オクタノール	10	エポキシ樹脂	15	——	
3	〃	〃	10	不飽和ポリエステル	15	分散剤	2
4	〃	〃	10	〃	20	分散剤	2
5	〃	〃	15	〃	15	——	
6	〃	α-テルピネオール	30	メチルセルロース	15	分散剤	2

Headings in table 1:
1. number, 2. main component, 3. binder composition, (weight parts), 4. solvent media, 5. organic additive material, 6. other additive materials, 7. phthalic acid diester, 8. octanol, 9. unsaturated polyester, 10. epoxy resin, 11. methyl cellulose, 12. alpha- terpineol, 13. dispersing agent, 14. glass.

[0048]

Practical Example 2

The mixed material 21 with the composition shown according to the presented in Table 2, was used and at the time when this mixed material 21 was filled into the molding sheet 20, the electrode material 22 was filled so that it covered it and everything else was done according to the technological procedures of the Practical Example 1. And by that a substrate plate 1, used in plasma display devices, was manufactured.

[0049]

[Table 2]

No	主成分	バインダー組成（重量部）					
		溶媒		有機性添加物		他の添加物	
7	ガラス	フタル酸ジエチル	10	不飽和ポリエステル	15	分散剤	2
8	〃	オクタノール	10	エポキシ樹脂	15	——	
9	〃	〃	10	不飽和ポリエステル	15	分散剤	2
10	〃	〃	10	〃	20	分散剤	2
11	〃	〃	15	〃	15	——	
12	〃	α-テルピネオール	30	メチルセルロース	15	分散剤	2

Headings in table 2 are the same as in the above described Table 1.

[0050]

[Practical Example 3]

As the electrode material W paste was used, and as the mixed material 21, as it is shown according to the presented in Table 3, alumina, zirconia with an average particle diameter in the range of 0.2 ~ 5 microns, was used, and the sintering temperature was made to be in the range of 1450 ~ 1600oC, and everything else was done according to the technological procedures of the Practical Example 1. And by that a substrate plate 1, used in plasma display devices, was manufactured.

[0051]

[Table 3]

No	主成分	バインダー組成（重量部）					
		溶媒		有機性添加物		他の添加物	
13	アルミナ	フタル酸ジエチル	10	不飽和ポリエステル	15	分散剤	2
14	〃	オクタノール	10	エポキシ樹脂	15	——	
15	ジルコニア	〃	10	不飽和ポリエステル	15	分散剤	2
16	アルミナ	〃	10	〃	20	分散剤	2
17	ジルコニア	〃	15	〃	15	——	
18	アルミナ	α-テルピネオール	30	メチルセルロース	15	分散剤	2

Headings in table 3:
1. number, 2. main component, 3. binder composition, (weight parts), 4. solvent media, 5. organic additive material, 6. other additive materials, 7. phthalic acid diester, 8. octanol, 9. unsaturated polyester, 10. epoxy resin, 11. methyl cellulose, 12.

alpha- terpineol, 13. dispersing agent, 14. alumina, 15. zirconia.

[0052]

Reference Example

On the other hand, as a reference example, according to the printing method used in the previous technology, on the manufactured from glass, back surface plate 10, the electrodes 12 were formed by using the screen printing method, and in the space between them, in order to form the barriers 11 the screen printing and drying were repeated 10 times, and after that, this was sintered at a temperature in the range of 500 ~ 700oC, and by that the substrate plate 1, used in plasma display devices, was produced (No. 19).

[0053]

For the obtained according to the above described No. 1 ~ 19, experimental materials, the shape of the barrier 11, the presence or absence of cracks and the deviation in the position of the electrodes were observed by using a binocular microscope, and the results from that are shown according to the presented in Table 4. According to these results, in the case of the No. 19, the shape of the barrier 11, was not defined and a deviation of the electrode 12 position, was observed. And contrary to that, in the case of the practical examples according to the present invention (No. 1 ~ 18), there was no deviation in the position of the electrodes 12 and the barriers 11, and the shape of the barrier 11 was also good. Moreover, in the case of the No. 6 and 18, because the amount of the solvent media was large, there was some destruction of the barrier 11, that was generated.

[0054]

Moreover, according to the above described practical implementation examples, a manufactured from glass back surface plate 10 is used, however, even when a plate manufactured from alumina etc., different types of ceramics, was used, the same results were obtained.

[0055]

[Table 4]

No.	隔壁の形状	クラックの有無	隔壁と電極の位置ずれ
1	良好	無し	無し
2	〃	無し	無し
3	〃	無し	無し
4	〃	無し	無し
5	〃	無し	無し
6	一部潰れあり	一部有り	無し
7	良好	無し	無し

8	〃	無し	無し
9	〃	無し	無し
10	〃	無し	無し
11	〃	無し	無し
12	一部潰れあり	一部有り	無し
13	良好	無し	無し
14	〃	無し	無し
15	〃	無し	無し
16	〃	無し	無し
17	〃	無し	無し
18	一部潰れあり	一部有り	無し
*19	形状が不明確	無し	ずれ有り

* denotes a reference example.

Headings in the table:
1. shape of the barrier, 2. presence or absence of cracks, 3. positional difference between the barrier and the electrodes, 4. good, 5. no, 6. there is on one part, 7. there is a deviation, 8. there is a partial destruction, 9. the shape is undefined.

[0056]

[Results from the present invention]

As it is clear from the above described, according to the present invention, the structure of a substrate plate used in plasma display devices is formed, as on a back surface plate, that is formed from ceramics or glass, numerous barriers, that are formed from ceramics or glass, are provided, and at the whole surface of the bottom surface of the cells that are formed in each space between these barriers, electrodes are provided. And because of that, the region of the electrical discharge is expanded and the light generation efficiency is increased and together with that it is a plate where it is possible not to have a deviation between the positions of the barriers and the electrodes.

[0057]

Also, according to the present invention, the manufacturing method for the preparation of that substrate plate used in plasma display equipment, consists of a

technological process where a mixed material, formed from ceramics or glass powder material a solvent media and organic additive materials, is filled inside the indented part of the molding die, and together with that on the protruded parts of the above described molding die, the electrode material is coated, and these mixed material and electrode material are bonded to the back surface plate, that is formed from ceramics or glass. And because of that, it is a plate that can be easily manufactured as the shape of the barrier is produced with a high accuracy, and not only that, but also, because of the fact that it is possible to form simultaneously the electrodes and the barriers, it is possible to simplify the manufacturing technological process, and by that, it is possible to reduce the costs.

[Simple explanation of the figures]

[Figure 1]

Figure 1 is a diagram of the substrate plate used in plasma display devices, according to the present invention.

[Figure 2]

Figure 2 (a) and (b) represent diagrams in order to explain the manufacturing method for the preparation of the substrate plate used in plasma display devices according to the present invention.

[Figure 3]

Figure 3 is a cross sectional view diagram showing a substrate plate used in plasma display devices according to the previous technology.

[Explanation of the symbols]

1.....substrate plate, 10.....back surface plate, 11.....barriers,
12.....electrodes, 13.....cells, 14.....electrodes, 15.....front surface plate,
20.....molding die, 20 a.....indented part, 20 b.....protruded part,
21.....mixed material, 22.....electrode material.

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Translated by Albena Blagev (735-1461 (h), 704-7946 (w))

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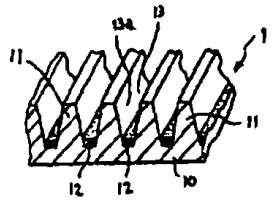
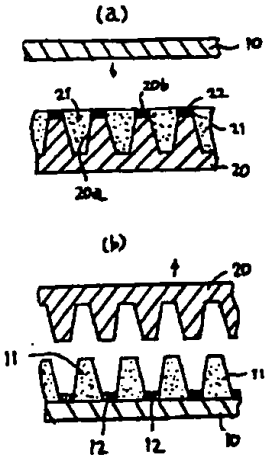
[Figure 1]



【図２】

[Figure 2]



【図３】

[Figure 3]